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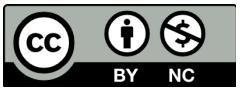

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Cultural Boundary Work when Inviting Constructivist Pedagogy into Polytechnic Schools

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ABSTRACT

In this study, we focus on a process of change in a polytechnic school in Denmark where the school management team decided to promote a non-traditional pedagogical approach. We examine teachers' moral evaluation of their own teaching, of students, and of learning during this transition in order to grasp the degree to which teachers needed to reconceptualize or reorient their traditional instructional roles and identities in order to meet the functional demands of the new forms of PBL-based teaching and learning. Based on qualitative interviews with teachers and heads of schools, we found that the process of change mobilized competing definitions of the legitimate teacher, the legitimate student, and legitimate knowledge in this organizational context.

Keywords: PBL, boundary work, organizational learning, pedagogical ideals

Introduction

All educational practices are based upon philosophical assumptions regarding the nature of students and the mechanisms that give rise to human learning (Hindhede & Hoejbjerg, 2020). Forty years ago, the academy perpetuated the myth that higher education faculty only needed expertise in their disciplines in order to be good teachers. More recently, however, research has emphasized the importance of faculty teaching ability, which relates to teachers' pedagogical beliefs, decisions, and judgments during teaching (Loucks-Horsley et al., 2009; Major & Palmer, 2006; Park & Oliver, 2008). In his cutting-edge work, Shulman (1986, 1987, 1991) puts forth that teacher knowledge is comprised of subject knowledge and pedagogical knowledge. Subject knowledge relates to the theories and principles of a particular discipline, whereas pedagogical knowledge is related to teaching itself, e.g., how to manage and organize a course.

When considering pedagogical knowledge, Johnson (2009) argues that there are two polarized ideals of learning. On the one hand, constructivism refers to educational practices that are student-focused, meaning-based, process-oriented, interactive, and responsive to student interest; on the other hand, instructivist practices are teacher-focused, skill-based, product-oriented, and highly prescribed. Citing Barrows (1996), Hung (2011) argues that problem-based learning (PBL), which represents a constructivist ideal of learning, is philosophically opposed to traditional instruction as it alters the roles of content, faculty, and student by being more in line with case-based practices in certain workplaces, such as business and medicine (Schmidt, Rotgans, & Yew, 2011). Thus, as argued by Mausethagen (2013, p. 132), when educational practices are altered, organizational tensions may revolve around what is viewed as internal (teachers' everyday work) and external (policies and practices beyond the main framework of teaching) to the teachers.

During transitions—such as when constructivist, PBL-based pedagogical approaches are introduced—teachers value and morally categorize their teaching practices (Kjellberg et al, 2013), and perhaps reshape their discourse in order to maintain legitimacy in the face of these new expectations. To date, however, few studies have focused on this kind of reorientation. Our study takes up this subject

as part of a broader research project by investigating the transformation of educational practices in a Danish polytechnic school where management decided to implement a PBL-oriented approach to teaching. We were interested in how headmasters, teachers, and students valorized learning, students, teachers, and content, and in what, in their opinion, gives rise to human learning. What is considered to be important for student development? Which competencies are privileged and by whom? To what extent does pedagogical reform introduce major changes in the discourses and competencies valued by management and teachers?

In order to investigate the norms and values or pedagogical ideals of teachers and management (Hindhede & Hoejbjerg, 2020) regarding the mechanisms that give rise to human learning, we draw on the concept of symbolic boundary work (Lamont, 1992; Lamont & Thevenot, 2000) to analyze how assessment and (e)valuation take place across a variety of situations. Lamont and Molnár (2002, p. 168) define boundary work as "conceptual distinctions made by social actors to categorize objects, people, practices, and even time and space" in order to "symbolically concentrate themselves and separate themselves from others as well as ways in which this is done for and to them by those in power." In this paper, the concept of boundary work helps us to comprehend pedagogy and learning as a societal categorization practice whereby management and teachers assess and categorize students, teachers, teaching, and learning in ways that delineate the legitimate from the illegitimate and the recognized from the non-recognizable. We argue that this is a fruitful approach in the face of inviting constructivism into a classic polytechnic school. Our focus is on which symbolic resources are at play in constructing, creating, and maintaining symbolic boundaries regarding the legitimate student, the legitimate teacher, and the legitimate pedagogy. These symbolic resources can be conceptual distinctions, interpretative strategies, universal principles, cultural traditions, forms of knowledge, use of history, figures of thought, and moral statements. We can identify these symbolic resources empirically, and we can observe the marking of boundaries in terms of formal features that relate to their visibility, constancy, rigidity, explication, implication, etc.

The Organizational Context

The School of Maritime Education and Teaching educates marine and technical engineers and has approximately 500 students and 45 employees; of those employees, 35 are teachers, and most have a long tenure at the school. Marine engineers have many and very different job functions and find employment in both public and private companies in a wide range of industries. Common job functions are operations, maintenance, sales, service, watch service, security, administration, financial management, and project management. The school has recently been certified to offer bachelor's degrees and thus it is regulated by the European Qualifications Framework Level 6.

Students come from various backgrounds. Applicants must have either an upper secondary school diploma or a background in a skilled trade. Before starting the three-year theoretical part of the program, applicants without a background in the skilled trades must attend a nine-month workshop course followed by a nine-month internship. The school is an old institution with proud classical traditions. Both recruiters and graduates are mostly satisfied with the education, there is a low unemployment rate among graduates, and the education is perceived by stakeholders as elite. However, the school faces certain challenges. From the management perspective, concern has been expressed as to whether the education is adequately future-proof (Trilling & Fadel, 2009). In addition, there is a desire to utilize resources more optimally because grants to higher education institutions are performance-based (Jongbloed & Vossensteyn, 2001) and almost half of the school's students fail their exams. Thus, re-exams and repetitive teaching draw heavily on the school's resources. Finally, the management holds the widely accepted assumption that there is untapped potential in IT-supported education for increased learning (Mischa & Koehler, 2006).

The training at the school must meet certain requirements (e.g., those of the Danish Maritime Authority). The program is structured with a theoretical component through which students are introduced to a variety of subjects, and these theoretical courses are supplemented by exercises in laboratories and on simulators. In the sixth semester, the student undertakes a company internship that is linked to their subsequent thesis assignment, which resembles a problem-based project report. The school's teachers are divided into teams based on subject knowledge. These teams meet on a regular basis to discuss semester and module planning.

School management has expressed the intention to use new, more engaging forms of teaching (Exley & Dennick, 2004), so that the education provided by the institution does not involve simply teaching to the test (Styron & Styron, 2012). There were multiple factors prompting this decision. For one, the school has large class sizes that invite student passivity, and social interaction between teachers/students and students/students is perceived as inappropriate, which in the long run may threaten the learning environment (Hmelo-Silver & Barrows, 2006). In addition, the resulting congestion of knowledge paired with a teacher-centred pedagogical approach burdens the individual teacher (Levinsen

and Nielsen, 2012); for example, supervising an entire team during laboratory teaching presents a challenge. As this traditional educational institution takes on new didactic challenges, our project aims to generate knowledge about this process. In this context, PBL, which brings an increased focus on problem solving, exemplarity, student activity, project management, and group work, as well as active collaboration with the surrounding community, is expected to challenge common notions of what is legitimate teaching. It will therefore also challenge notions of who the teachers perceive as legitimate teachers and as legitimate students.

The headmaster, in collaboration with the university, designed this year-long process of change as a research project. Planned in close collaboration with the education managers, the transition involved a number of workshops for all teachers distributed evenly throughout the course of the year. These workshops included the principles of PBL (Hmelo-Silver & Barrows, 2006), didactics to increase student activity (Schmidt et al., 2015) and the use of IT tools in teaching (Bishop & Vergeler, 2013). The project was designed so that teachers could develop their teaching practices based on the knowledge gained during workshops.

Research Methods

In examining these changes, we were interested in teachers' and management's representations of the degree to which teachers needed to reconceptualize or reorient their traditional instructional roles and identities in order to meet the functional demands of the new forms of teaching and learning.

Before the workshops, we made observations of 24 lectures. In making the classroom observations, our focus was on how the teacher balanced different types of in-class activities (lecturing, discussing, exercises, and perhaps feedback), with attention to the following factors:

- Structure: the way the teaching material is presented and whether the structure is communicated to students.
- Presentation style: e.g., body language and speech, but also the overall impression of the teacher's attitude, including whether the teacher seemed well prepared.
- Information distribution: e.g., different ways of getting the message across, including the use of pre-prepared notes (e.g., slides), on-the-spot notes (e.g., by use of blackboards), or references to cases, examples, quotes, and theory.
- Student interaction: including any way the teacher interacts with students beyond presentation and information distribution.
- Student behaviour throughout the learning activity.

We also interviewed the headmaster and three educational leaders. Inspired by our theoretical framework, we asked them to describe the ideal student, the ideal teacher, and the ideal pedagogy for learning.

When the teachers had participated in three workshops (one on the principles of PBL, one on didactics to increase student activity, and one on how to use IT tools in teaching), we interviewed seven teachers individually. In these interviews, in order to see if aspects of the workshops were reflected in the teachers' points of view/considerations, we asked them to define the legitimate student, the legitimate teacher, and the legitimate pedagogy, with their own teaching as point of departure. At that point, we also participated in four group meetings where teachers discussed semester and module planning. Here, our focus was on the norms regarding what could be considered the legitimate student and the legitimate pedagogy.

Interviews with leaders and teachers and the group meetings were recorded and transcribed verbatim. Participants were informed about the aim of the project and were asked for informed consent. They were promised anonymity and could withdraw from the study at any time and for any reason. In the analysis, we systematically analyzed the transcripts for underlying meanings, beliefs, presuppositions, justifications, and intentions in relation to pedagogical ideals, and we also analyzed the symbolic resources they drew on and how boundaries were marked. The transcripts were also analyzed for repeated occurrences of boundary work.

In the following section, we present the cultural boundary work and teachers' valuations in relation to pedagogical ideals about what is the "right" knowledge and how it is best shared and their valuations of teaching conditions, and finally, we discuss how to best assess learning at the school.

Findings

From our preliminary observations of classroom interactions, we found that in general, classroom discourses were dominated by lectures where the teacher stands in front of the class, talks, and shows slides to address content, while also striving to create environments that were dialogic in character. Students were engaged in the classroom by discussing material in pairs or by working in small groups with mathematical problem-solving. In general, the pedagogical ideal in classroom teaching seemed to be rote memorization

and students being able to reproduce large chunks of information. In the labs, students were divided into groups where they did pre-defined practical exercises using lab technology, under teacher supervision. In general, attendance in lectures and lab exercises was high.

After we observed classroom teaching, we interviewed R11, the headmaster, who explained the school's intention to undertake this organizational development towards a constructivist pedagogical approach. The motivation was related to both the recent status of the education as a bachelor's program and to the Danish government's stated decrease in financial support to institutions of higher education. R11 explained his vision for the outcome of the changes:

> If we do not develop our education quickly enough so that the courses reflect the new goals we need to deliver on, that is, a higher level of learning and a higher degree of letting the students being the active ones... well then we would end up having a school that is too expensive in delivery costs (...) the culture must change so that the teachers think differently in terms of learning, and not just stand by the blackboard and teach for 17 weeks, for 24 hours per week. Because this is not in alignment with up-to-date learning or teaching methods, we have all these students failing their courses. (R11)

R11 addresses internal issues when he expresses the wish to re-conceptualize institutionalized repertoires such as the appropriate number of lectures per week. He also addresses external forces, such as the Danish qualifications framework that stipulates the requirements for the marine engineer education. Both are used as arguments for initiating the change process. He draws boundaries between present practice, which is categorized as teachers teaching subject knowledge (the principles, theories, and concepts of the discipline), and future practice, which involves a higher focus on pedagogical knowledge about teaching itself, which—in his opinion—has not been sufficiently addressed. He draws these boundaries by creating distinctions between present teaching and what he refers to as higher levels of learning. He also draws boundaries between active and passive students and sees the current students as being passive. He also marks a correlation between current teaching methods and high exam failure rates.

We will now present findings from our analyses of teachers' symbolic boundary work in relation to pedagogical ideals: to what is considered the "right" student, the "right" teacher and the "right" kind of knowledge to be learned during marine engineer education. We will then discuss how symbolic boundaries may lead to barriers and challenges in the organization when PBL is introduced.

Boundary work relating to the "right" student and the "right" teacher

As for pedagogical ideals concerning the student and the teacher, we found the following:

- The ideal student solves math problems with ease and is active in class and in lab exercises.
- The ideal teacher gives examples of their own experiences of how marine engineering is practiced but keeps knowledge at the theoretical level.
- The ideal teacher takes a central role in the classroom rather than taking a more peripheral role facilitating student learning.
- The ideal teacher keeps project work to a minimum due to diversity in student learning dispositions.

Regarding the ideal student, all teachers mentioned that the students had different learning dispositions and that the ones with a background in a skilled trade benefited from life experiences. However, the students who were constructed as "the high-end students" (R3) were the ones who were very good at maths and were among the few "who ask clever questions during or after class" (R2). They were compared to another group of students that were considered "weak" (R1) and "not having the disposition at all for enrolling in a bachelor's degree program" (R2). Another way of categorizing students related to the activities initiated by teachers in the classroom: "the weak students finish much more quickly if it is a 'talking-task' and spends much more time on a 'calculation-task' and vice versa for those who are brighter" (R1).

According to one of the teachers, R2, the weak students, who were so labelled because they received a zero grade (which is below the passing level), were passive both in class and in lab exercises, and were a cause for concern about introducing more project work:

> Some of our students are freewheelers, and they do not contribute much. They may show up in class, but they only watch and do not participate actively, and when a report is to be written, they may make the front page and then the smart guys of the group are writing the entire report. So I think this is a problem if we are going to have project work across all semesters. Those who did the project will, of course, not be grouped with those who did not contribute at all. If we have to work with problem-based learning, then I guess the best thing is to group the "zeroes" together, although we

> might then do them a great disservice. But the high-end students will not accept being grouped with the zeroes. (R2)

R2 further explained that based on the information discussed in the workshops, the members of his teaching group changed their exams in order to test students on their practical ability. According to R2, this led the weaker students to display more interest in participating in the exercises and getting hands-on experience, rather than only observing their classmates.

Another example of symbolic boundary work comes from a teacher group meeting in which five teachers constructed themselves as "nurses" when expressing concern that they may have "helped [students] too much" (R6), which may have resulted in reinforcing a traditional school-pupil role for students instead of promoting self-directed learning. In this conversation, the teachers drew on their own experiences as students, setting this as the ideal for planning modules and semesters; for example, they discussed how one should construct education so that ultimately the students learn how things are interrelated. This in turn led to the distinction between quality teaching and poor teaching, whereby quality teaching occurs when the teacher provides examples of how marine engineering is practiced, although knowledge must be kept at the theoretical level. An example of this is expressed by R7:

> I think that a marine engineer is practical in his DNA, and that's what I tell them: "you are practical so you must be able to understand that now we have to build on some theory to get you ready for real life." Because we talk a lot about practice and that bothers me because when I studied civil engineering for five years, I calculated on ship hulls, castings, and airplane wings, and I've never seen a ship hull or airplane wing, but I did well anyway. How long did it take me afterward to find out how the hull of a ship is constructed? Three months or half a year, and then I was ready for practice. We must not forget that we fill in some theory and the practical stuff must come afterward. (R7)

Preparing for class was also an issue that gave rise to normative valuations and categorizations about the right kind of teacher. Whereas most teachers complained about students being lazy and not doing their homework, others took the side of students and linked their non-preparedness to external forces by arguing that it was due to attending 24 lecture hours per week. As an exception from these two lines of rhetoric, R1 takes a third approach:

> I tell the students that the body of knowledge in the field of marine engineering is difficult to comprehend, and then I use a technique that I call loop back pedagogy where I go over the content rather superficially. I even sometimes say to students: "I hope you have not prepared at home. Now I will explain, and digest for you and then you can go home and read afterwards." Then I repeat the following two or three lessons. I also make them do calculation assignments. I tell them that they need to understand because the education is very comprehensive so you cannot memorize it all. (R1)

As R1 constructs students as not being able to think for themselves, he does not compel students to study the material before class. Rather, he constructs acceptable student behavior as coming to class unprepared, then sitting back to let the teacher digest the knowledge for them. Here, R1 is the expert and students are the novices that risk mislearning if they attempt to guide themselves. He therefore designs his teaching so that many lessons are spent repeating content to help students understand, while at the same time explaining to students that they will not be able to memorize it all. He is the kind of teacher that supports the present model of many lecture hours and few self-study hours per week, something that the head of school wants to change.

R2 also likes to engage students in class by giving examples from his previous job as a marine engineer when he teaches Ohm's law. However, he also maintains that students need not know why they have to learn about Ohm's law, as this insight will be gained later. In his valuation of knowledge, it is of utmost importance that the students develop the skills they need in order to apply problem-solving algorithms:

> Just as you have a hammer and a saw in your toolbox, here we have Ohm's law and Kershoff's law and the like. These are basic tools you need to know about. Later, the students can learn how to use these tools when building houses or whatever tasks they need to solve, but first they need to learn how to use the basic tools in the calculative assignments I give them. (R2)

In the PBL workshop, we explained how the discourse of PBL positions the student in particular ways (the student as problem-setter, problem-solver, etc.), and how lectures are generally a poor medium for enhancing student attention and motivation (Bligh, 1972; Powell, 2003). In relation to this, R9 explained his experiences of introducing PBL in the fourth semester: "I'm now trying to run something with a mower where they just have to figure out how it works. That's an enormous challenge for them!"

Thus, like R2, most of the teachers expressed the norm that the students needed to attain a certain level of maturity to take responsibility for their learning and become problem-setters and -solvers. A few others did not see the need for PBL. An example of this is the following quote from R3:

> In my opinion, we are all good at engaging students, especially within the fields of expertise where you have equipment that they have to learn to use. We also do a lot of traditional classroom teaching where you give the students an example and then let them calculate something to engage them as soon as they display off-task behaviours. I also do this. My experience is that it works better if you vary your methods rather than saying now, we only work with problem-based learning because I simply don't believe in that. (R3)

R3 constructs PBL as something that is distinct from his approach to classroom teaching and believes that his way of teaching also engages students. He therefore thinks that transforming pedagogy to PBL alone would not work in this organization. According to R3, the teacher should emerge as the central figure in influencing learning transactions taking place in the classroom, rather than taking a more peripheral role in facilitating the learning process.

Boundary work relating to the "right" kind of knowledge

In terms of the right kind of knowledge, we found the following:

- The right knowledge is based on convergent rather than divergent thinking, at least in early semesters.
- The right knowledge is complex and theoretically based.
- The right knowledge is dictated by external forces that also dictate the curriculum.
- The right knowledge is defined internally through struggles among teachers.

One general theme of the first three workshops was the question of how problem-solving encourages deeper conceptual and inferential thinking. When asking respondents to reflect on this, most of the teachers marked boundaries between informal, experiential knowledge and formal, disciplinary knowledge, and the majority emphasized the latter as being crucial for a marine engineer. Teachers praised a teaching method whereby science is seen as factual knowledge to be memorized and achievement gains are measured by frequent use of multiple-choice tests for intelligence, thus emphasizing convergent rather than divergent thinking (Cropley, 2006).

However, despite this prioritization of formal, disciplinary knowledge, all of these teachers problematized the large amounts of time they needed to spend on repetition in order to imbue such knowledge. To explain the module design choices that included this repetition, they referred to external forces such as consolidation acts, the recruitment panel, and the industry, as well as what they would expect of the acquired competencies of the newly qualified marine engineer. They expressed objections to removing too much subject knowledge in order to accommodate a PBL method because they worried that they as teachers would no longer be able to control the learning outcomes. One of the teachers, R5, describes his experiences with using problems as the starting point of a lecture:

> I have to teach them some theory first before they can figure out what a cooling system is. What you said at the workshop about learning by doing does not make sense at all. They have to learn some theory first, and then we do something with that knowledge, like then they may choose to do a cooling project, and then they can build on the theory and do it in practice. I have tried to introduce the practical parts before theory, but it is a complete waste of time. We end up spending half a day on nothing; well, maybe the students have had a great time, but they have learnt nothing. (R5)

Like R5, all seven teachers put great emphasis on highly complex competencies, but in their daily practice they were confronted with a majority of students that were categorized as having difficulties understanding and learning this complex knowledge:

> Our students have a very mechanical way of learning. When I give them assignments with calculations on electric motors, on transformers and electric blowers, they use prefabricated templates to solve the problems and sometimes they include numbers that have absolutely nothing to do with the task I have set them (...). We talked about how to deal with this problem at a group meeting where your colleague said, "Why not instead ask students to explain how they will solve the assignment?" I think that is a brilliant idea that we had not thought of ourselves. (R1)

Another teacher, R4, describes how the subject knowledge has changed since he went through his own education as a marine engineer. At that time, "the content was entirely technique and calculating whereas a topic like management was

allocated a couple of days of the three years." He explains how input from the recruitment panel has resulted in changes to the curriculum so that management and finances now comprise 25% of the students' education.

However, not all of these changes are due to external forces; instead, they arise from tensions related to internal issues, such as the allocation of hours to each of the courses taught:

> The students learn too much about electrical technology compared to what they need after graduation. We spend too much time on how an electrical engine is built, the materials used for building it, and so on. Not that this is not interesting, but as an operations manager in fact you only need to know that there is a difference between this type of engine and this type of engine. What we have done so far is to have students calculate the result with two dashes underneath! In reality, it is more important to be able to describe a curve and discuss how it will change over time. (R4)

As stated by R4, (too) much of the curriculum relates to the topic of electrical technology, which is where many of the students fail. R3 agrees and explains:

> I have joked about the electrical licensing test on which we actually spend many of our resources. I was previously employed at a power plant where we were 92 engineers and the one with the electrical license was a strong-flow engineer, so you can see that very few use that authorization after graduation. (R3)

In this organization, boundaries are constructed between groups of teachers based on distinctions related to the teacher's power to set norms of what should be taught. For example, one topic that arose in the workshops was the possibility of working in a more cross-curricular way in order to create a common thread throughout the program, focusing on integrating subjects. However, to the majority of interview respondents, cross-curricular organization was seen as a challenge due to the struggles over what the curricula should be. In addition, some teachers maintained that, in their own way, they were already using problem-based approaches, drawing distinctions between calculative assignments and talk assignments. These talk assignments would be, for example, giving students an assignment where they have to run a cooling system and explain what happens. However, such talk assignments are usually distinct from true PBL assignments because it tends to be the teachers and not the students who decide on the problem.

Another topic in the workshops was how academic feedback is more strongly and consistently related to achievement than to any other teaching behavior (Bellon et al., 1991) as it can improve the student's self-awareness and enthusiasm for learning. However, one of the teachers, R10, describes how they had previously experimented with projects in an earlier semester and that feedback on project reports had been an issue. So rather than asking whether this experiment failed due to students' lack of motivation or skill, the lack of success now appeared to be due to the teachers' lack of motivation:

> At that time, we collaborated with a pump store, where they have measuring instruments and you click on an iron pipe, then you don't have to drill holes, you send in some ultrasound and then you can measure how much water is running in the pipe (...). There was discussion about who should assess which parts of the parts of the project they had produced. Many of us are not "method people" so to speak, so the methodical and the scientific issues of how things are written; well, I consider myself a technician and have always gotten low grades on essays, so grading students' written reports is such a bore (...). If our everyday life was filled with the feedback culture that the students really ask for and we spend our time only giving feedback on teaching we have video recorded and then flipped, well then this can seem a little daunting to many of us... (R10)

As stated by R10, in this organization, teachers prefer traditional classroom teaching where students see the teacher as the expert. They dislike the idea of playing a more peripheral role as a facilitator and spend time providing detailed personalized feedback on assignments, as this may force them to reorient their ideals of the "right" type of teacher. Other teachers mentioned that the later semesters of a student's education include interdisciplinary components that are not being used sufficiently. To explain their lack of success, the teachers cite administrative issues such as time allocation. As no one has hours allocated to this job and "as long as no one tells us to do it, nothing happens" (R3).

A few of the teachers were more open to the idea of PBL and working in an interdisciplinary way. R3 pitched the following idea:

> We have nice simulator over there, and it involves knowledge about electricity, about machinery, about control, process, and automation. If you designed it sensibly, you could let the students work with maintenance, management calculation, and operational management calculation, and so on. (R3)

R3's construction of the right kind of knowledge does not emphasize linking discipline knowledge and life knowledge. Nonetheless, he has many ideas about how to combine topics—although this was not how the teachers themselves had been taught marine engineering.

Boundary work relating to teaching conditions

As for teaching conditions, the following boundaries were constructed:

- A shortage of exercise labs prevents increased use of project work in teaching.
- A lack of skilled teachers in the labs prevents increased use of project work in teaching.
- Outdated and poor quality textbooks make teaching more difficult.
- Evaluation procedures lower the intended learning goals.

We did find various indications that teachers took inspiration from the workshops, changing their lectures to a more PBL-oriented approach and promoting critical thinking to their students. For example, in a group meeting with six teachers, one of the teachers reflected on his own learning process:

> The students need much more time in the laboratory. When working with mutual induction and such, I remember from my own school days that we dipped a magnet into a coil of copper wires and then you could see that the voltmeter deflected. It was a huge moment for me. I learned a lot from that exercise. The same happened with a couple of wires lying on a laboratory table, and then you send power through and then you can see how they splash apart. This is the time when you start to link theory to real experiences (R3).

However, these teachers further discussed how the physical surroundings in terms of both lack of capacity and the low number of labs presented a challenge for implementing PBL. One of them pointed to the fact that the electronics lab needs to be equipped with knowledgeable staff: "You can't just let students go down there on their own, as they could be killed" (R2). Another issue in their discussions related to the outdated textbooks. They explained to us how some of the teachers had therefore written their own textbooks. Others had constructed a curriculum with books that "could not really be used" (R1). In these courses, students needed to attend the lectures to better understand the material, "because there are a lot of things in the books we use that are described so poorly that if you don't show up at lectures, then you do not stand a chance" (R1). Other teachers explained that the school's culture and evaluation system had made them fearful of student assessment of their teaching. R9 explains:

> When I started, many teachers told me to "just take it easy," and "if you say something that is not correct, it doesn't matter." Christ! I say something wrong all the time! The worry about saying something wrong or forgetting things, I simply can't figure out why this should be such a problem? (R9)

In this school, students evaluate their teachers twice every semester. If a teacher gets a poor evaluation, they are asked to attend a meeting with the head of school. Here they need to present a lengthy explanation of their teaching methods and what they will change in the near future. In the final evaluation, right before students take their exams, many students give harsh feedback, stating that the teacher is not engaging and that they have learned nothing. They do this because if they fail the exam, they can then make a complaint and blame the teacher for not being good enough.

Discussion and Conclusion

In this paper, we have investigated the process of change within a polytechnic school that introduced PBL into a previously non-PBL-oriented organization. We drew on symbolic boundaries as a theoretical framework to better comprehend the distinctions that the teachers make when they are asked to describe their pedagogical ideals. This approach revealed the way in which most instructors had distinct preferences for teacher-led instruction, which in their opinion guided higher-level knowledge. They indicated skepticism regarding collaborative problem solving as an alternative way of designing modules.

We also found that across teacher groups, there was a link between cultural attitudes/practices and indirect forms of power. This was especially evident when some of the teachers explained how too much emphasis was placed on teaching electronics, which demonstrated that groups of teachers had the power to decide that their courses should take up the most space in the curriculum. Thus, tradition played a large role in determining what information was transmitted to students throughout the program, and one group of teachers had upheld the right to teach their special interest rather than thinking about maximizing student competencies as fully trained marine engineers. Thus, there were internal group struggles over over what the learning goals should be and over exactly what should be expected of the students when they graduate.

A challenge in this type of organization is certainly that the staff may be divided into two groups; namely, those who think that professional arguments should guide what is taught and those who think that the curriculum should be more problem-oriented. At the end, this relates to what competencies the students will need upon entering the profession. In this organization, some teachers feel that students need basic prerequisites in order to better understand what is happening on later semesters, and therefore the program must focus on subject knowledge. Another group of teachers was opposed to the extent of electronic knowledge required of the students on early semesters, in which students needed to know everything in detail from different angles. This tension between qualifications and subject knowledge implied that some teachers realized that they were guiding the students too much rather than treating them as reflective individuals: once the teachers have shown one way of accomplishing a task, then the students may reach a similar result by following other routes independently.

Boundaries were strategically employed when teachers cited reasons for not changing their current methods. For example, whereas students were generally required to do pre-reading before each class, we also observed disinclinations relating to student preparation. Those teachers who wanted their students to avoid preparing in advance believed that accepting that the teacher is the expert is important for student development. Some teachers had previously placed students in small groups, a practice which draws on cooperative learning structures. However, overall, individual math competencies were prioritized over practical abilities.

We also found that teachers and school management were not always in alignment about what is the right kind of knowledge and the right kind of teaching. In his boundary work, the headmaster primarily focused on potential tensions relating to external forces such as whether the education was adequately future-proof and whether it reflected what was necessary for professional qualification. The reasons the headmaster referenced for adopting the constructivist pedagogy of PBL (Hendry et al., 1999) were a wish to utilize resources more optimally and frustration over the many resources spent on re-exams and repetitive teaching. In comparison, teachers valorized present forms of learning. They self-defined as the experts, and many teachers believed that PBL would not work for academic achievement and problematized the effectiveness of PBL. To them, catapulting students to new, uncomfortable spaces where the problem may provoke new ways of thinking was not a possible or desirable option.

The majority of teachers were reluctant to accept the idea of integrating subjects and working in a more project-oriented way. They worried about the students not leaning enough when introducing PBL. Prince (2004, p. 229) explains that "while no evidence proves that PBL enhances academic achievement as measured by exams, there is evidence to suggest that PBL 'works' for achieving other important learning outcomes," such as "developing more positive student attitudes, foster[ing] a deeper approach to learning and help[ing] students retain knowledge longer than traditional instruction." In this study we have left out student perspectives on the right kind of knowledge and the right kind of teaching.

In the PBL teaching environment, the teacher-as-facilitator uses different ways of teaching and allows teaching to be flexible. In this organization, however, complex pedagogical dichotomies arise when teachers balance the need to explicitly deliver expository subject knowledge while at the same time giving instructions that actively construct students' own knowledge. Many of the teachers had conceptualized their role as being the central figure in influencing learning transactions taking place in the classroom. Therefore, the idea of playing a more peripheral role as a facilitator reoriented this identity to a degree that made them especially reluctant.

As described by the management, many teachers taught to the test by focusing exclusively on information shared with students through slides or writing on the blackboard. However, we also saw signs of teachers realizing that acquiring knowledge should rate as more important. This corresponds to the findings of Schmidt et al. (2015), who found that students who feel they lack knowledge do not resolve this problem by consulting textbooks; rather, their knowledge of the domain becomes superficial and abbreviated. This could explain the high number of students failing exams. One possible solution to this problem was proposed by Schmidt et al. (2015), who argued that the most fundamental problem of lectures is that they tend to be based on the information transmission fallacy, i.e., the assumption that what is taught by the teacher is what is remembered by the student. Instead of lectures, students can discuss subject matter with peers, present subject matter to others, etc., as "these constructive activities, aimed at improving memory and transfer, are at the core of attempts to make lectures more effective" (Schmidt et al., 2015, p. 17).

We acknowledge some limitations of this study. Since we have not presented a full view of all 35 teachers' opinions, we therefore cannot say to what extent pedagogical reform may introduce major challenges for management. Moreover, after the workshops took place, we were not able to do further observational studies to help us better comprehend whether the teachers were in fact able to transform their pedagogy to a more constructivist approach. Our own position in the field is also worth a mention: Due to our cooperation with the school's management, during the workshops

we put forward particular distinctions of which pedagogies are more legitimate than others and of what may make one teacher more legitimate than another. Our presence and the fact that the teachers knew our position and stances might have an impact on their responses in interviews and group meetings. Thus, our role as consultants and the teaching interventions we conducted by means of the workshops have ultimately influenced the data that we collected; for example, when teachers talked to us about active learning, this was because we had covered that topic in our workshops.

In this study, we analyzed the viewpoints of teachers and management in relationship to boundary work, which in turn involves power issues. Teachers' power appears as legitimate categorizations and moralizations in relation to their professional work at a polytechnic school, but power is also exerted through their categorization choices as these teachers evaluate and interpret pedagogy and best teaching practices. This means that the teacher is a cultural producer, possessing by virtue of their profession symbolic power to create, recreate, distribute, and apply culture. In turn, this power is socially conditioned. While the teachers at a polytechnic school are the dominant holders of power in undertaking boundary work, they are also informed and influenced by external forces.

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